Canadian Aviation Safety Board

Bureau canadien de la sécurité aérienne

Civil Aviation Occurrence Report

Canada

The Canadian Aviation Safety Board investigated this occurrence for the purpose of advancing aviation safety. It is not the object of the Board to determine or apportion any blame or liability.

AVIATION OCCURRENCE REPORT

PIPER PA-31-310 NAVAJO CF-BBR
RANKIN INLET,
NORTHWEST TERRITORIES 2 mi NW
12 NOVEMBER 1986

REPORT NUMBER 86-H60004

SYNOPSIS

The aircraft departed Rankin Inlet on a night visual flight to Pelly Bay. Approximately one minute after take-off, the aircraft crashed and burned 1.4 miles off the end of the runway. The five occupants died in the crash.

The Canadian Aviation Safety Board (CASB) was unable to determine the cause of the accident.

Ce rapport est également disponible en français.

27 June 1988

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5.0 APPENDICES

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1.0 FACTUAL INFORMATION

1.1 History of the Flight

On 12 November 1986, a Piper PA-31 Navajo, CF-BBR, departed Churchill, Manitoba at 1710 Central standard time (CST)* with the pilot and three passengers on board for a flight to Rankin Inlet, Northwest Territories. The aircraft landed at Rankin Inlet at 1846 CST. The pilot and passengers deplaned, and, approximately one and one-half hours later, the aircraft with the pilot and four passengers on board taxied for a take-off on runway 31 for a flight to Pelly Bay, Northwest Territories. The aircraft took off at 2041 CST, and, 50 seconds later, the Rankin Inlet Flight Service Station (FSS)** operator received an emergency locator transmitter (ELT) signal. Shortly thereafter, the operator observed a red glow beyond the departure end of runway 31 and activated the crash alarm. The airport manager, RCMP, and fire-fighters were dispatched to the scene and found that the aircraft had crashed and was on fire.

The accident occurred at 2042 CST during the hours of darkness, at lat 62°49'N, long 92°09'W, at an elevation of 40 feet*** above sea level (asl).

1.2 Injuries to Persons

	Crew	Passengers	Others	Total
Fatal	1	4	-	5
Serious	-	-	-	-
Minor/None	-	-	-	-
Total	1	4	-	5

1.3 Damage to Aircraft

The aircraft was substantially damaged on impact and destroyed by the ensuing ground fire.

1.4 Other Damage

- Nil -

* All times are CST (Coordinated Universal Time (UTC) minus six hours) unless otherwise stated.
** See Glossary for all abbreviations and acronyms.
*** Units are consistent with official manuals, documents, reports, and instructions used by or issued to the crew.

1.5 Personnel Information

1.5.1 General

	Pilot-In-Command
Age	45
Pilot Licence	Private
Medical Expiry Date	01 November 1987
Total Flying Time	1,100 hr
Total on Type	50 hr
Total Last 90 Days	22 hr
Total on Type Last 90 Days	22 hr
Hours on Duty Prior to Occurrence	N/A
Hours off Duty Prior to Work Period	N/A

The pilot had a private licence with a night endorsement and was qualified to fly single- or multi-engined land aircraft up to 4,000 pounds maximum certified take-off weight. The pilot had received his night and multi-engine endorsements flying his previously owned Piper PA-34-200T, which has a maximum take-off weight of 4,570 pounds. There is no record of an application for a PA-34 endorsement, and the pilot did not have an endorsement for a PA-31, which has a maximum take-off weight of 6,500 pounds. The pilot's flying times are estimated as his log book was not located. As well, there is no record of the amount of night or instrument flying experience the pilot had. He did not have an instrument rating.

1.5.2 Pilot History

September 1982 - received student pilot permit;
September 1982 - three convictions for operating a commercial air service without a valid and subsisting certificate (Air Reg. 700);
February 1984 - received private pilot licence;
February 1984 - on a special visual flight rules (VFR) flight, the pilot had a near miss with a commercial B-737 aircraft while flying above an undercast cloud layer;
April 1984 - the pilot took off in marginal VFR weather, became lost, and required assistance from the pilot of another aircraft to land;

April 1984	- the pilot's private licence was suspended based on the February and April 1984 incidents;
May 1984	- temporary private pilot licence issued after further training and testing;
May 1984	- received private pilot licence;
September 1984	- received night endorsement;
September 1984	- received multi-engine endorsement.
November 1984	- on a VFR flight, the pilot encountered deteriorating weather, became lost, and was unable to locate the airport without ATC assistance. The aircraft propeller and wing tip were damaged on landing or while taxiing to the parking area.

1.6 Aircraft Information

1.6.1 General

Manufacturer	Piper Aircraft Corporation
Type	PA-31 Navajo
Year of Manufacture	1969
Serial Number	31377
Certificate of Airworthiness	Valid
Total Airframe Time	3,575.7 hr
Engine Type (2)	Lycoming TIO-540-A1B
Propeller Type (2)	Hartzell HC E3YR-2A-CR
Maximum Allowable Take-off Weight	6,500 lb
Recommended Fuel Type	100/130

The aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures.

The pilot took delivery of the aircraft on 11 November 1986 after having had a 50-hour inspection and numerous modifications completed at Regina, Saskatchewan. The most significant work was the installation of engine heaters, two NYACK auxiliary fuel tanks in the engine nacelles, a new fuel bladder, and an interior car heater to warm the aircraft instruments. Following the work, the aircraft was reweighed and flight tested.

The aircraft technical log book(s) and the journey log book have not been located.

1.6.2 Weight and Balance

The maximum PA-31 take-off weight is 6,500 pounds. At take-off from Rankin Inlet, the aircraft weighed approximately 7,000 pounds which was derived as follows: basic weight - 4,394 pounds; occupants - 893 pounds; full fuel load - 1,424 pounds; and baggage - 300 pounds (estimated from witness accounts). The PA-31 centre of gravity (C of G) chart does not provide data for aircraft weights above 6,500 pounds. Extrapolation of the data, however, indicates that there is no allowable C of G range at 7,000 pounds weight.

1.7 Meteorological Information

The weather forecast for Rankin Inlet for the period 1700 CST 12 November 1986 to 0500 CST 13 November 1986 was sky partially obscured, scattered cloud based at 2,000 feet mean sea level (msl), visibility three miles in blowing snow, and wind from 320 degrees true at 15 gusting to 25 knots. The weather was variable to sky partially obscured, broken cloud based at 2,000 feet msl, and visibility one mile in blowing snow.

The recorded weather at the time of the accident was thin scattered cloud at 15,000 feet msl, visibility 10 miles in ice crystals and drifting snow, temperature minus 27 degrees Celsius, and wind 340 degrees true at 18 knots. Similar conditions had existed for the previous three hours.

1.8 Aids to Navigation

Rankin Inlet aerodrome has a very high frequency omnidirectional range (VOR), distance measuring equipment (DME) and non-directional beacon (NDB); all were functioning normally at the time of the accident.

1.9 Communications

CF-BBR was communicating with Rankin Inlet FSS on very high frequency (VHF) radio. During the accident flight, there were two VHF transmissions between CF-BBR and the FSS: first, a check-in to initiate the flight; and second, an acknowledgment by CF-BBR of an FSS transmission passing the take-off time.

1.10 Aerodrome Information

Rankin Inlet has one gravel-surfaced runway which is oriented 31/13 and is 5,000 feet long by 150 feet wide. The runway is equipped with runway identification lights (flashing strobes) and a visual slope indicator system (VASIS), both of which were serviceable. At the time of the occurrence, the runway condition was good with a frozen gravel surface.

1.11 Flight Recorders

The aircraft was not equipped with a flight data recorder or a cockpit voice recorder, nor was either required by regulation.

1.12 Wreckage and Impact Information

The aircraft crashed 1.4 miles off the departure end of runway 31 and 550 feet to the left of the extended runway centre line. The aircraft struck the ground in a wings-level, nose-down attitude and then slid 160 feet before coming to rest in an upright position with all major airframe components intact. Small pieces of aircraft from the fuselage, cabin, and baggage areas were scattered along the wreckage path. The engine cowlings, nose baggage door, and left engine spinner were thrown forward in front of the aircraft. The fuselage, left wing, and left horizontal stabilizer were almost completely destroyed by the post-impact fire. There was no evidence of pre-impact fire.

The aileron, rudder, and elevator control cables and rods were all intact at and in the immediate vicinity of the control surfaces; however, the integrity of the cables to the cockpit controls could not be verified because of fire damage. The aircraft flaps and landing gear were in the up position. The aileron trim was neutral, and the elevator trim tab was about three quarters of an inch nose-down with the elevator in the neutral position.

1.13 Medical Information

Autopsies were performed on the five bodies for identification purposes and to determine if any pre-accident medical condition, of the pilot in particular, could have contributed to the accident. The bodies were identified; however, because of the severe fire, complete autopsies were not possible.

Hydrogen cyanide (HCN) has been found in victims of previous aircraft accidents where the aircraft have burned, so an attempt was made to determine HCN concentrations in these victims. It was determined that HCN was not present in one of the bodies; it was not possible to determine whether there was HCN present in the others.

1.14 Fire

The aircraft caught fire immediately following the impact and was destroyed except for the engines, the right wing, and most of the empennage.

1.15 Survival Aspects

The aircraft struck the ground with sufficient force to dislodge the seats and/or break the seat-belts; all the aircraft occupants were found in the forward area of the aircraft. It is probable that the pilot and passengers were killed on impact.

The fire ignited immediately after impact and was so intense that it would not have been survivable. Because of the rough, snow-covered terrain, fire-fighting equipment could not reach the accident site. Small dry-chemical extinguishers were used in a futile attempt to control the fire.

1.16 Tests and Research

The engines and propellers were examined at the CASB Engineering Laboratory. The extent of the fire damage to both engines precluded any determination of the condition of any of the engine systems or accessories. Essentially, all that could be determined was that there was no evident internal failure of either engine prior to impact that could have limited the ability of the engines to produce power. The internal engine parts exhibited no evidence of improper fuel type being used. Engine power output at impact could not be determined from examination of the engines.

Both propellers were in the normal pitch operating range and being driven at the time of impact. The extent of damage and the severity of twist in some of the propeller blades suggest relatively high rotational speed.

Piper Aircraft Corporation estimated the probable flying characteristics of the aircraft at the estimated take-off weight and conditions. They advised that, with both engines operating normally, no adverse effects should be encountered but that control response would be extremely sensitive.

1.17 Additional Information

1.17.1 Aircraft Passengers

The pilot was on a personal business trip and was accompanied by a friend. Three members of the clergy of the Catholic Church were passengers on the aircraft, visiting certain northern communities.

1.17.2 Aerodrome Fire-Fighting Equipment

A fire-fighting vehicle was available at the Rankin Inlet Airport; however, the vehicle was not capable of reaching the crash site. The vehicle was suitable for travel on prepared surfaces but was not capable of travel on the frozen, snow-covered tundra.

2.0 ANALYSIS

2.1 Introduction

The aircraft became airborne before reaching the end of the runway and remained in the air until it struck the ground 1.4 miles further on. The flight profile is not known; however, on impact, the aircraft was heading opposite to the track to the planned destination. The state of the wreckage and the length of the wreckage trail indicate that the aircraft struck the ground at relatively low vertical and forward speeds.

2.2 Flight Analysis

The fire damage to the aircraft made it impossible to determine whether the aircraft controls were functioning normally or how much power the engines were developing. The only apparent aircraft factors that would affect performance were the overweight and centre of gravity conditions of the aircraft.

An overweight aircraft can be forced into the air at its normal take-off speed, that is, the take-off speed for the maximum allowable take-off weight. The aircraft will fly and may accelerate while in ground effect but then may or may not fly when out of ground effect, depending on the speed reached. If the aircraft is grossly overweight, it may be flying at a speed at which aircraft drag exceeds the power available to climb or accelerate. When flying in this condition, any attempt to turn or climb could precipitate an aircraft stall.

The diagram at Appendix A shows that, as aircraft weight increases above 4,800 pounds, the allowable centre of gravity range decreases. Extrapolation of the graph above 6,500 pounds leads to the conclusion that, unless an aircraft was loaded precisely, it would be likely that its centre of gravity would be either forward or aft of a stable position, if in fact there was a stable position. An aircraft flying in such a condition would be extremely sensitive to control inputs. As well, it may not be possible to maintain the aircraft in a desired attitude, no matter what the control inputs.

Since the area off the end of the runway was dark and offered no visual cues, the aircraft would have had to be controlled with reference to its flight instruments. Normally, this may not present a problem; however, given the probable controllability problems described above, an inexperienced instrument pilot would have extreme difficulty in maintaining aircraft control. The lack of outside visual cues combined with control difficulties could also easily lead to pilot disorientation.

2.3 Pilot Performance

The pilot's flying history combined with the fact that he took off with an overloaded aircraft indicates a lack of appreciation for safe-flying practices. It could not be determined if his attitude or actions were causal in this accident.

3.0 CONCLUSIONS

3.1 Findings

1. The pilot was not endorsed to fly the PA-31 aircraft.

2. The aircraft was approximately 500 pounds over the maximum allowable take-off weight.

3. There were no visual cues off the end of the runway to assist the pilot in maintaining aircraft control without reference to the aircraft instruments.

4. The pilot had previously been convicted of regulatory infractions which together with Findings 1 and 2 indicates a lack of appreciation for safe-flying practices.

5. The aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures.

6. The aircraft was destroyed by the post-crash fire.

7. Due to the almost complete destruction of the aircraft by the crash and fire, the Board was not able to determine whether any pre-impact failure or condition contributed to this accident.

3.2 Causes

The aircraft crashed shortly after take-off for undetermined reasons.

4.0 SAFETY ACTION

4.1 Safety Concerns

4.1.1 Aircraft Operating Beyond Weight and Balance Limitations

The disregard for safety whereby pilots continue to operate aircraft in excess of the maximum allowable weight limitation is cause for continuing safety concern. The CASB has already issued three recommendations pertaining to this matter (CASB 85-01, 85-02, and 85-25). The Department of Transport also has long recognized this problem and has taken regulatory, enforcement, and promotional measures to reduce the frequency of aircraft operating beyond their weight and balance limitations. While the CASB has no new information to introduce at this time warranting new recommendations, the Board believes that the entire aviation community must sustain a relentless effort to improve operator awareness of the hazards associated with flying overweight or out-of-balance aircraft.

4.1.2 Pilots with a History of Infractions

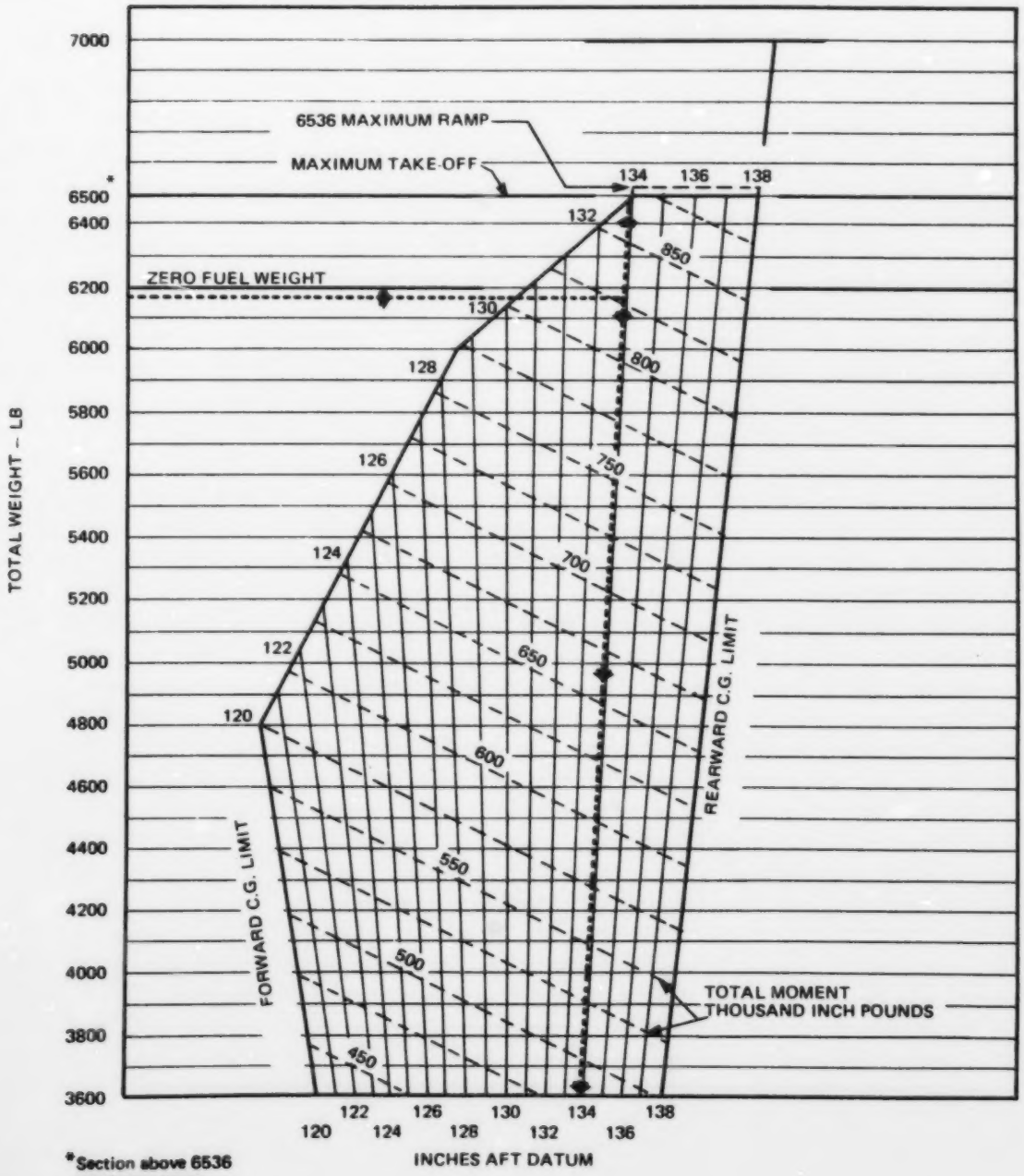
Other accidents investigated by the Board have involved pilots with a recent accident history. The Board is concerned that pilots with a history of disregard for regulations, marginal competence or serious errors in judgement frequently are involved in regulatory infractions or accidents. Although the cause of this latest accident has not been determined, the pilot's disregard for regulations and good airmanship, as demonstrated by his enforcement history, underline the Board's concern in this regard. The Board believes that better methods for identifying high risk pilots and monitoring their performance may be in order. The Board will continue to examine the phenomenon of pilots with a history of repeated aviation occurrences or regulatory infractions and will make formal recommendations if warranted.

4.1.3 Night Disorientation of VFR Licensed Pilots

Night or low visibility conditions pose unique difficulties for pilots licensed only for VFR operations. The loss of outside visual cues under such conditions requires pilot reference to the aircraft performance instruments to maintain attitudinal control of the aircraft. Following a preliminary review of

accident data over the past 10 years, the Board is concerned that the frequency of occurrences where night disorientation may have been a contributing factor is disproportionately large for pilots who are licensed only for VFR operations. Such pilots typically have very limited experience and training in flying only with reference to the aircraft's performance instruments. The CASB will study this issue to determine whether aviation safety recommendations are warranted.

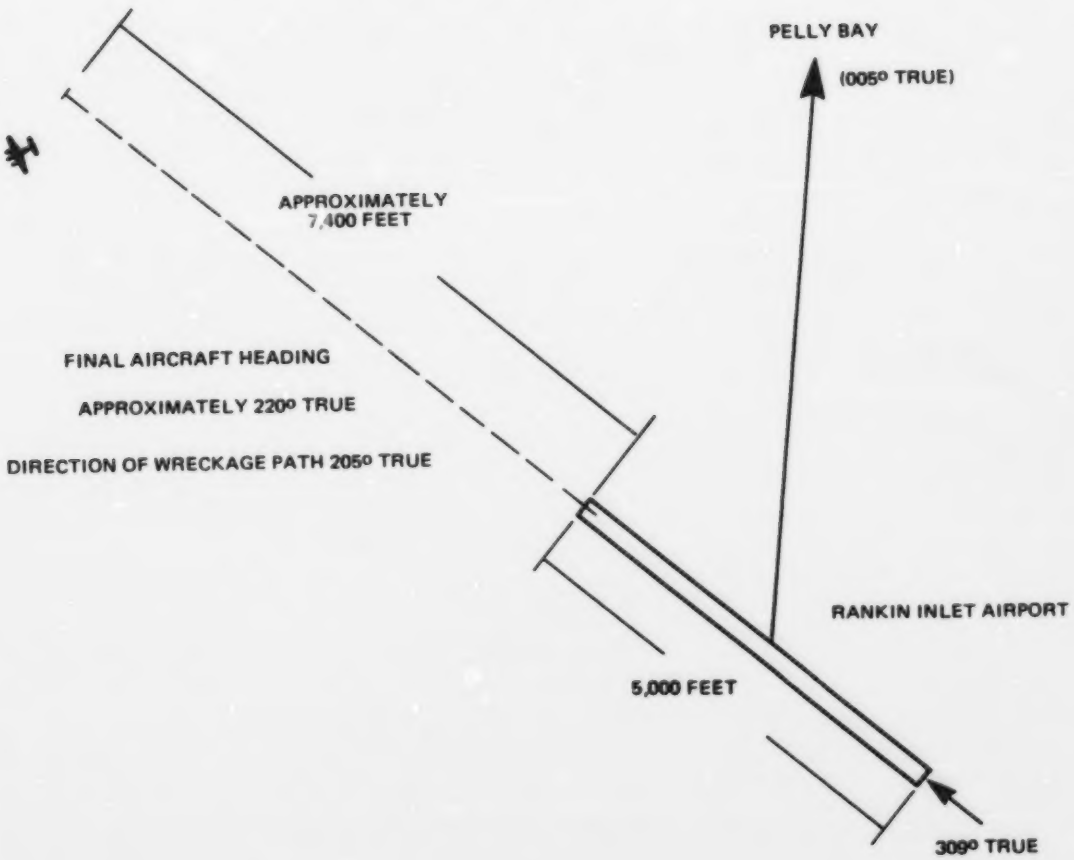
GROSS WEIGHT - TOTAL MOMENT
CENTER OF GRAVITY
PA-31



*Section above 6536 maximum ramp inserted by CASB

APPENDIX B

ACCIDENT AREA



APPENDIX C

LIST OF LABORATORY REPORTS

The following laboratory reports were completed:

LP 285/86 - Propeller Blade Angle Analysis, CF-BBR

LP 286/86 - Engine Power Analysis, CF-BBR

These reports are available on request from the Canadian Aviation Safety Board.

GLOSSARY

asl	above sea level
ATC	air traffic control
CASB	Canadian Aviation Safety Board
CST	Central standard time
C of G	centre of gravity
DME	distance measuring equipment
ELT	emergency locator transmitter
FSS	flight service station
hr	hour(s)
IFR	instrument flight rules
msl	mean sea level
NDB	non-directional beacon
N	north
RCMP	Royal Canadian Mounted Police
VHF	very high frequency
VOR	very high frequency omnidirectional range
VASIS	visual approach slope indicator system
VFR	visual flight rules
W	west
°	degree(s)
'	minute(s)